SECTION 11608

GLOVEBOX DESIGN

****

LANL MASTER CONSTRUCTION SPECIFICATION

When editing to suit project, author shall add job-specific requirements and delete only those portions that in no way apply to the activity (e.g., a component that does not apply). To seek a variance from applicable requirements, contact the Engineering Standards Manual (ESM) Mechanical POC.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Information within "stars" is provided as guidance to the author responsible for revising the specification. Delete information within "stars" during editing.

This specification serves as a template. The specification was prepared by an organization operating under a quality assurance program that meets the requirements of 10 CFR 830 (suitable for ML-1 through ML-4 projects). Implementation of this specification requires modification to the specification to meet project-specific requirements. Responsibility for application of this specification to meet project-specific requirements lies with the organization modifying or implementing the specification. The organization modifying the specification shall apply a graded approach to quality assurance based on the management level designation of the project. When this specification is used with nuclear facilities subject to 10 CFR 830, modification to this specification must be performed by an individual or organization operating under a quality assurance program that meets the requirements of that CFR.

This specification is a general specification covering a wide range of nuclear materials glovebox applications. It should be used for defining glovebox design requirements and for providing guidance to glovebox design agencies, including Architectural/Engineering (A/E) contracting firms and LANL design groups. It shall also be used in conjunction with Section 11610 for glovebox design/build procurements. This specification is most applicable to new acquisitions, but may have application with modifications or repair work to existing gloveboxes.

This specification primarily defines requirements for design of stainless steel gloveboxes used for confinement of nuclear materials. Other materials may be used for the design and fabrication of the glovebox, including aluminum, provided that the process and corrosive requirements inside the glovebox are met. Redefine the specification requirements when specifying a glovebox fabricated from a material different than stainless steel.

NOTE: Portions of this specification consist of quotations and paraphrases from the American Glovebox Society, Guideline for Gloveboxes, AGS-G001-1998. In the interest of providing a useable and readable specification, quotations and paraphrases have not been footnoted throughout the text. Paraphrases and quotations have been identified in italics. The users of this specification are encouraged to review the Guideline for Gloveboxes and to use the guideline appropriately. During revision and final issue of the specification, change italics to standard text.

****

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Glovebox Shells

B. Open-Front Boxes

C. Airlocks

D. Glovebox Support Stands

E. Gloveports

F. Windows

G. Filter Housings

H. Shell Penetrations

I. Access and Service Panels

J. Material Transfer Devices

K. Radiation Shielding

L. Glovebox Linings

M. Pressure Relief Devices

N. Other Glovebox Appurtenances

1.2 SCOPE

A. This specification establishes the technical requirements for the design and quality assurance (QA) of gloveboxes, their support stands, and components or appurtenances of gloveboxes.

B. The technical requirements of this specification are applicable to gloveboxes used for the primary and secondary confinement of nuclear materials. Additional technical requirements are provided in the contract drawings. Any additional requirements specific to a given glovebox are identified in contract documentation identified in Division 1 documents.

C. The following is a summary of supplier responsibilities described in this specification:

1. Design gloveboxes in strict accordance with this specification, the contract drawings, and the referenced documents.

2. Furnish design data required by this specification to document design of the glovebox.

3. Provide a design schedule showing major design steps, submittal milestones, review periods, and as-built documentation. Provide a revised design schedule after any modification to the contract documentation, which revises the design requirements, required delivery date, or when other approved LANL changes otherwise change a scheduled design task.

4. Provide LANL full access to the facility for performing random or scheduled inspections and/or surveillance of work performed.

5. Provide LANL with a lower tier services plan including the name, address, telephone number, and point of contact for outside services that the supplier intends to use on this project. Identify the specific work requirements of this specification that will be performed by those outside service providers.

****
Edit applicable related sections defined below to meet the project requirements associated with the glovebox to be designed.

****

1.3 RELATED SECTIONS

A. Section 01015: LANL/Contractor Furnished Property and Services

B. Section 01330: Submittals

C. Section 01600: Materials and Equipment

D. Section 01630: Product Options and Substitutions

E. Section 01700: Contract Closeout

F. Section 01720: Project Record Documents

G. Section 11610: Glovebox Fabrication

H. Section 11614: Glovebox Gloves

I. Section 11616: Glovebox Feedthroughs, Hermetically-Sealed

J. Section 11618: Glovebox Atmosphere Regenerable Purification Systems

K. Section 11620: Glovebox Installation

L. Section 13085: Seismic Protection

M. Section 13420: Glovebox Instrumentation

N. [Section 15053: Process Piping [future]]

O. Section 15075: Mechanical Identification

P. Section 15215: Compression Fittings on Copper and Stainless Steel Tubing

Q. Section 15865: Filters

R. Section 15885: HEPA Filtration System

S. Section 15950: Testing, Adjusting and Balancing

T. Section 16111: Conduit

U. Section 16112: Surface Metal Raceway

V. Section 16120: Building Wire and Cable

W. Section 16130: Boxes

X. Section 16195: Electrical Identification

Y. Section 16450: Secondary Grounding

Z. Section 16510: Interior Lighting System

1.4 DEFINITIONS

A. Access Panel: A removable and resealable panel used for interior access.

B. Airlock: A transition enclosure for material movement into and out of the glovebox that maintains the primary confinement. The term “transfer airlock” is sometimes used interchangeably with airlock. An airlock is sometimes purged with inert gasses.

C. Glovebox: A controlled environment enclosure providing primary confinement from the work area. Operations inside gloveboxes are performed through sealed glove openings for the protection of the worker, the environment, and/or the process.

D. Hood: An enclosure similar to a chemical fume hood. A non-isolated enclosure for controlled access to a glovebox that may also be used independently as a stand-alone unit or in a line with other hoods. Confinement is achieved through airflow in a hood. Hoods can also be used for low-level analytical chemistry operations. Can also be referred to as an Open-Front Glovebox, Introductory Glovebox, or Radio-Benches. For the purposes of this specification only, the term Hood will be used interchangeably with Open-Front Glovebox, Introductory Glovebox, and Radio-Bench.

E. Primary Confinement: The barrier (structure) that is directly in contact with bulk radioactive material. The barrier, that if breached exposes the bulk radioactive material. Primary confinement is pipes and vessels in a tritium system. Primary confinement in an SNM process may be process piping and vessels or may be the glovebox when solids are exposed in machining and handling processes.

F. Secondary Confinement: Secondary confinement is a structure erected around primary confinement for the purposes of creating a barrier to block migration of unanticipated and anticipated breaches of the primary confinement. Gloveboxes are secondary confinement in a tritium system or a wet chemistry SNM process where they isolate releases of radioactive materials when the process piping must be opened.

G. *Shielded Gloveboxes: A shielded glovebox is a glovebox provided with radiation shielding. Depending on process conditions, certain gloveboxes may be shielded by the addition of gamma shielding and/or neutron shielding covering the front, sides, back, and bottom of the glovebox as required. This shielding may be covered by stainless steel.*

H. Supplier: A contractor providing services to LANL.

1.5 ACRONYMS

A. ACGIH: American Conference of Governmental Industrial Hygienists

B. AGS: American Glovebox Society

C. ALARA: As Low As Reasonably Achievable

D. ANSI: American National Standards Institute

E. ASME: American Society of Mechanical Engineers

F. ASTM: ASTM International (formerly American Society for Testing and Materials)

G. AWS: American Welding Society

H. CD: Capacitive Discharge

I. CFR: Code of Federal Regulation

J. CMAA: Crane Manufacturers Association of America

K. CRL: Central Research Laboratories

L. DBE: Design Basis Earthquake

M. DOE: Department of Energy

N. ICBO: International Council of Building Officials

O. IES: Illuminating Engineering Society of North America

P. LANL: Los Alamos National Laboratory

Q. LIR: Laboratory Implementation Requirement

R. NEC: National Electric Code

S. NFPA: National Fire Protection Agency

T. NPH: Natural Phenomena Hazard

U. NQA: Nuclear Quality Assurance

V. OSHA: Occupational Safety and Health Administration

W. QA: Quality Assurance

X. SSC: Structures, Systems, and Components

Y. UBC: Uniform Building Code

1.6 REGULATORY REQUIREMENTS

Codes, specifications, and standards referred to by number or title form a part of this specification to the extent required by the following references and others that may exist in this document. Use codes, specifications, and standards referenced below of the latest revision at the time of award of contract, unless otherwise stated below.

A. 10 CFR 830.122: Quality Assurance Criteria

B. 10 CFR 1910: Occupational Safety and Health Administration (OSHA) Standards

C. ACGIH: Industrial Ventilation

D. AGS-G001: Guideline for Gloveboxes

E. ANSI/IEEE 1023: Guide for the Application of Human Factors Engineering

F. ASME B18.2.1: Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws

G. ASME B30.16: Overhead Hoists

H. ASME B30.2 1: Manually lever operated Hoists

I. ASME B46.1: Surface Texture

J. ASME HST-4M: Performance standard for Overhead Electric Wire Rope Hoists

K. ASME HST-3M: Performance standard for Manually lever operated Hoists

L. ASME NOG-1: Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)

M. ASME NQA-1: QA Program Requirements for Nuclear Facilities

N. ASME Y14.5M: Geometric Dimensioning and Tolerancing

O. ASTM A240: Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels

P. ASTM A480: Flat Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip

Q. ASTM D1056: Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

R. ASTM D2000: Standard Classification System for Rubber Products in Automotive Applications

S. AWS A2.4: Symbols for Welding, Brazing and Nondestructive Examination

T. CMAA Specification No. 70

U. DOE Order 6430.1A: General Design Criteria (Division 11)

V. DOE-STD-1020: Natural Phenomena Hazards (NPH) Design and Evaluation Criteria for Department of Energy Facilities

W. DOE-STD-1021: NPH Performance, Categorization Guidelines for SSCs

X. LANL Engineering Standards Manual, including Chapter 5, Structural

Y. LANL Drafting Manual

Z. LANL LIR 230-01-02: Management Level Determination

AA. LANL LIR 402-300.01: Criticality Safety

BB. LANL LIR-402-700-01: Occupational Radiation Protection Requirements

CC. NFPA 70: National Electrical Code

DD. NFPA 101: Code for Safety to Life from Fire in Buildings and Structures

1.7 SUBMITTALS

A. Provide reference to LANL Contract Number, Glovebox Number, Glovebox Title, and Drawing Number on correspondence.

B. Provide submittals listed in Attachment 4 and in accordance with the requirements of Section 01330, Submittal Procedures.

****
Determine whether the kick-off meeting is required and the appropriate time for the kick-off meeting.

****

1.8 KICK-OFF MEETING

A. Hold a half-day kick-off meeting at Los Alamos, NM within 10 working days after award of the contract. The kick-off meeting may be waived at the discretion of LANL. Provide technical documentation required for submittal at the kick-off meeting conference even if a kick-off meeting is not held. Review the following at the kick-off meeting:

1. Contract document provisions.
2. Design requirements.
3. Technical specifications.
4. Contract drawings.
5. Supplier's lower tier services plan.
6. Supplier's QA manual.

****
Determine and specify schedule requirements including required delivery date if critical.

****

1.9 SCHEDULE

A. Provide a design schedule showing design steps, design submittal milestones, and review periods. Include milestones associated with the design phases, 30%, 60%, 90%, and 100%. Provide design schedule to LANL, for approval, at the kick-off meeting.

B. Indicate design phases and review periods. Plan on a 10 working day period for each LANL review cycle.

C. Provide a revised design schedule for LANL approval within 7 working days of a modification to the contract document, which revises the required delivery date, or when other approved LANL changes otherwise change a schedule assembly step hold point, test, or inspection.

****
Determine and specify any additional design hold points required on a project-by-project basis.

****

****
The following quality assurance requirements are consistent with design of a ML-1 and ML-2 glovebox. Where other quality assurance and quality control requirements are needed, modify the following section accordingly. For instance, the supplier may also apply a QA program in accordance with basic requirements of 10 CFR 830.122. Add requirements for QA Programs compliant with 10 CFR 830.122 to the specification as necessary.

****

1.10 QUALITY ASSURANCE/QUALITY CONTROL

A. Maintain a QA program in accordance with certain Basic Requirements of ASME NQA-1, QA Program Requirements for Nuclear Facilities.

B. QA Manual (Design): Submit an uncontrolled copy of the supplier's QA Manual for approval. Address the following NQA-1 Basic Requirements in the QA Manual:

1. Basic Requirement 1: Organization
2. Basic Requirement 2: Quality Assurance Program
3. Basic Requirement 3: Design Control
4. Basic Requirement 4: Procurement Document Control
5. Basic Requirement 5: Instructions
6. Basic Requirement 6: Document Control
7. Basic Requirement 7: Control of Purchased Items and Services
8. Basic Requirement 15: Control of Nonconforming Items
9. Basic Requirement 16: Corrective Action
10. Basic Requirement 17: Quality Assurance Records
11. Basic Requirement 18: Audits

C. Comply with the information contained in the supplier's drawings and in related specification sections, referenced in the contract, during detail design of gloveboxes.

D. Upon completion of the detailed design, as a minimum, perform the mechanical design checks as indicated in the following sections, prior to issue of information for acceptance.

1. Check assemblies to ensure that parts function correctly under defined conditions, that they have the correct relative proportions, that the general design is correct in the matters of strength, rigidity, bearing areas, appearance, convenience of assembly and that there are not interferences.
2. Check dimensions to see that they are correct. In checking dimensions, note particularly the following points:
   a. See that figures are correctly depicted and that they will print clearly.

b. That the overall dimensions are given.

c. That witness lines lead to the correct part of the drawings.

d. Proper allowances are made for fits.

e. Tolerances are correctly given where necessary.

f. That dimensions are compatible with the corresponding dimensions of adjacent parts.

g. Compliance with ASME Y14-series documents.

3. In addition, address the functionality of the detailed design and confirm that the criteria set out in Attachment 3 are met.

1.11 EXCEPTIONS, DEVIATIONS, AND CONFLICTS

A. Submit a written request to LANL for any proposed technical changes, exceptions, and/or deviations to this specification or the contract drawings. Submit proposed changes that affect cost or schedule in accordance with the provisions of the contract document.

B. Conflicts: Notify LANL in the event of conflicts amongst the specifications, drawings, and/or the manufacturer's recommended processes or instructions. Provide notification of a conflict immediately following its discovery. Provide notification in written form, or via phone call followed by facsimile.

1.12 SITE CONDITIONS

A. Design gloveboxes and associated components for a design altitude of 7,500 feet above sea level.

B. Design gloveboxes and associated components for a design ambient temperature of 70° F.

PART 2 PRODUCTS

2.1 PRODUCTS AND SUBSTITUTIONS

A. Comply with Section 01630, Product Options and Substitutions.

****
An approved suppliers list shall be established for glovebox design suppliers in accordance with the appropriate Quality Assurance Program Plan. Authors shall select suppliers from the approved suppliers list.

****

2.2 SUPPLIERS

A. Companies specializing in glovebox design.

2.3 MATERIALS

A. None. Refer to PART 3 – EXECUTION for design deliverable requirements.

PART 3 EXECUTION - DESIGN

****
The author is required to define many aspects of the glovebox design. Designate management level of the glovebox in accordance with LIR 230-01-02, Management Level Determination. Following the designation of management level, interpret the requirements for the designated management level and define those requirements in this specification.

****

3.1 GENERAL REQUIREMENTS

A. Some glovebox drawings have been previously produced for repeated use in LANL glovebox design. A drawing list is provided in Attachment 1 of this specification. Use existing, proven designs as represented in Attachment 1, where available. Provide any new designs in compliance with the requirements of this specification.

B. *Provide glovebox design compatible with the process to be housed within the glovebox and allow for equipment to be installed and removed.*

****

Perform the following analyses or define requirements for the following within the specification:

- *Conceptual sketch or drawing of the glovebox.*
- *Glovebox materials of construction.*
- *Glovebox coating or lining requirements.*
- *Glovebox atmospheric requirements including inert atmosphere requirements, where applicable.*
- *Performance Category of glovebox to meet requirements of LANL Engineering Standards Manual, Structural Chapter, DOE-STD-1020 and DOE-STD-1021.*
- *Building or facility floor loading limitations considering total glovebox plus shielding weight.*
- *Glovebox operating and design pressure and temperature.*
- *Perform hazards analysis of glovebox and associated equipment. Determine necessary hazard mitigation systems and their associated management level. Include the type, range, location, action to be taken, and warning signals in the analysis. Characterize hazards to ensure glovebox adequacy.*
- *Include glovebox pressure control analysis and gas flow into or out of the glovebox.*

- *Need for ventilation filters. Determine type and size, and methods for replacement.*
- *Fire detection and suppression requirements. Include requirements, where necessary, for fire barriers, thermowells, heat sensors, automatic door closure, sprinklers or gas and fire department call out. Consider the fire impact from total weight of combustible radiation shielding.*
- *Perform radiation shielding analysis, where appropriate. Determine and specify shielding type and thickness. Consider the ergonomic impact from radiation shielding thickness and weight.*
- *Determine and provide requirements for fall protection and load bearing requirements to perform hook-up and maintenance on or from top of glovebox.*
- *Perform nuclear criticality analysis in accordance with LIR 402-300-01, where appropriate. Determine requirements for design of criticality prevention systems, allowable materials of construction, allowable configurations and geometry of items interfacing with materials at risk.*
- *Determine and provide requirements for toxicity, potency, pressurized vessels, or other special hazards.*
- *Determine and provide requirements for human factors, lighting, sound, stature, reach, ventilation, and ambient temperature. Recommended parameters for some of these elements can be found in Section 5 of the AGS Guideline for Gloveboxes.*
- *Need for elements of machine and electrical guarding as required in 10 CFR 1910, Subpart S OSHA.*
- *Clearances on passageways, work areas, and surfaces. Maintain egress aisleways in accordance with NFPA 101, Code for Safety to Life from Fire in Buildings and Structures.*
- *Glovebox surface finish (inside and outside), as it affects cleanability and decontamination. Consider ergonomic impact from surface finish. Reflectivity from too highly polished surfaces can make working at gloveboxes for long periods of time uncomfortable.*
- *Design for decommissioning of gloveboxes and equipment inside.*
- *Perform safety/hazards analysis review as design progresses.*

****

****
Define the supplier's design approach and provide requirements for submittal of design documents. Require that a systems design approach is followed such that internal process equipment is designed in conjunction with the glovebox so that system requirements are met. Provide the glovebox designer with complete internal process equipment arrangements prior to design of the glovebox, where possible. Consider design for maintainability, operability and safety during design of equipment directly associated with the glovebox, so that the glovebox can be designed appropriately.

****

3.2 APPROACH

A. Perform designs in a phased approach including 30%, 60%, 90%, 100%, and As-Built, with LANL design reviews. The 90% submittal typically constitutes a complete design package for final review by LANL.

B. 30% Design: The 30% Design Phase includes a kick-off meeting, and development of design requirements (or design plan), drawings, and analyses. Provide documents in the 30% design phase sufficient to identify a preliminary layout of the glovebox depicting a preliminary glovebox support stand design and cutouts for windows, service panels, access panels, and gloveports. Indicate orthographic views of gloveboxes and overall glovebox size on drawings. Include the following:

   1. Partially completed assembly drawings showing arrangement of the glovebox structure, process equipment, connection locations for services, connection to other gloveboxes (if any), major glovebox components, and appurtenances.
   2. Drawing list or design plan for the completed design deliverable.
   3. Piping and Instrumentation Diagrams (P&ID).
   4. Preliminary electrical, hydraulic/pneumatic, process, and instrumentation and controls (I&C) schematics.
   5. Preliminary seismic calculations.

C. 60% Design: The intent of the 60% design phase is to incorporate comments from the 30% design review and to further development of glovebox fabrication drawings. Include sufficient dimensioning to locate cutouts on the glovebox shell drawings. Depict views of the assembly without balloons and call-outs on the glovebox assembly drawings. Depict approximately 60% of the necessary dimensions for fabrication on the glovebox support stand drawings. Include the following:

   1. Partially completed assembly drawings with balloons and call-outs for major components including subassemblies.
   2. Control logic and wiring diagrams.
   3. Hydraulic/pneumatic diagrams.
   4. Electrical wiring diagrams.
   5. Documents showing continued progress from the 30% design as identified above.

D. 90% Design: The intent of the 90% design phase is to incorporate comments from the 60% design review and to complete the glovebox fabrication drawings and analyses. Complete drawings during the 90% design phase and include bills of materials, material callouts, dimensions, tolerances, and weld maps. Where required, provide seismic analyses of the glovebox support stands during 90% design phase. Include the following:

   1. Completed piping drawings.

2. Completed electrical drawings (wiring diagrams, equipment arrangement, mounting details, conduit routing, components list, etc).

3. Completed I&C drawings (logic diagrams, wiring diagrams, equipment arrangement, mounting details, conduit routing, components, list, etc).

4. Completed process equipment details (arrangement, components, mounting details, etc.).

5. Seismic analyses.

6. Calculations.

7. P&IDs.

8. Hydraulic/pneumatic diagrams.

9. Connection drawings, instructions, and anchorage details.

E. 100% Design: Incorporate LANL comments from the 90% design review and submit the drawings, analyses, and documentation identified above for final review and signature by LANL.

3.3 DOCUMENT AND DRAWING REQUIREMENTS

A. General

1. Maintain required records in accordance with the supplier’s quality assurance program plan.

B. Engineering Documents

1. Develop documents in a legible fashion and in the English language. Develop engineering documents using Microsoft Word. Provide calculations in a typewritten fashion or handwritten in pencil or black ink. The use of software packages like MathCAD and Microsoft Excel for development of calculations is acceptable. Request approval from LANL for use of any other software package not defined herein.

2. Validate and benchmark software used for calculations including engineering calculations, cost estimates, etc. in accordance with the supplier’s quality assurance procedure requirements.

3. Document calculations with sufficient information on the purpose of the calculation, the design basis, assumptions, reference data, methods, results and conclusions to permit a technically qualified reviewer, including LANL, to determine their suitability for the intended purpose without recourse to the originator.

C. Drawings

1. Develop drawings in accordance with the LANL Drafting Manual and standard industrial machine design practices. Where the following requirements conflict with the LANL Drafting Manual, the Drafting Manual takes precedence. Include the following in glovebox drawing packages: assembly drawings, shell drawings (weldment) showing window openings, gloveport locations, and other openings with welded appurtenances; miscellaneous details; dimensioning; tolerancing; parts list; and weld maps.

    a. Develop and produce drawings in accordance with ASME Y14-series documents.

    b. Provide dimensional tolerances in accordance with ASME Y14.5M.

    c. Provide surface texture symbols in accordance with ASME B46.1.

    d. Provide welding symbols in accordance with AWS A2.4.

    e. Use symbols for piping and instrumentation in P&IDs in accordance with LANL Engineering Standards Manual OST220-03-01-EM, Mechanical Chapter, P&ID Section.

****
Define and specify project specific requirements for CAD programs and format of drawing delivery.

****

    f. Produce drawings using a commercial Computer Aided Design/Drafting (CADD) application. Provide electronic files of design drawings in drawing exchange format (.dxf) or AutoCAD format (.dwg).

    g. Provide a drawing list of drawings generated with the glovebox drawing package. Update list as design progresses. Transmit list as title sheet of drawing package each time drawings are transmitted to LANL.

    h. Provide sufficient detail on drawings to show materials for components, weld details, dimensions, and tolerances. Do not show welds that join sheet material of the glovebox shell on the shell weldment drawings.

    i. Include manufacturer’s name and applicable manufacturer’s part or model numbers for vendor references, when included in bill of materials on drawings or included on data sheets.

D. *Dimensioning*

1. *Dimension square and rectangular openings on glovebox shells to the edge of the opening, not to the center of the opening.*

2. *Use baseline dimensioning in preference to string dimensioning, to avoid tolerance build-up.*

E. Tolerances

1. Specify tolerances for gloveboxes and sheet metal fabrication on drawings in accordance with LANL Drawing 26Y-202001, “Standard Glovebox Fabrication Requirements,” ASME Y14.5M, and section 6.1.10 of the AGS Guideline for Gloveboxes, AGS-G001. Modify tolerances for glovebox shell fabrication accordingly when designing especially large gloveboxes up to 100-feet in length.

2. Use the following tolerance block for drawings of machined parts.

GENERAL NOTES

1) DIMENSIONS AND SYMBOLOGY ARE AMERICAN NATIONAL STANDARD UNLESS OTHERWISE SPECIFIED.

2) DIMENSIONS AND TOLERANCES ARE IN INCHES.

3) BREAK ALL SHARP EDGES.

4) MACHINED SURFACE ROUGHNESS 125 rms OR BETTER.

5) TOLERANCES:

DECIMALS:	.X	= ± .030
	.XX	= ± .010
	.XXX	= ± .005
FRACTIONS:	± 1/16	
ANGULAR:	± 1°	

3.4 GENERAL PRINCIPLES AND PERFORMANCE REQUIREMENTS

A. Design glovebox to provide a complete and permanent confinement of the equipment and processes within it under normal operating and incident conditions.

****
Define the utilities that will interface with the glovebox and the necessary penetrations required in the glovebox. Also specify spare services and penetrations as required.

****

B. Include provisions for necessary services and penetrations as required to ensure glovebox operability in the design.

C. Provide design of gloveboxes that accounts for methods of manufacture and inspection and testing.

****
Define the negative operating static pressure range of the glovebox below.

****

D. *Design gloveboxes to maintain a negative operating static pressure, between [negative 0.5 and negative 1.5] inches water gauge (w.g.) such that contaminant escape due to "pinhole type" leaks is minimized and so that transportation of contaminants out of the glovebox is prevented.*

****

Define planned fluctuations of ventilation pressure and temperature. Also define the criteria for rigidity of the glovebox shell.

****

E. Design the glovebox structure to be rigid enough to resist deflections caused by ventilation pressure differentials, temperature fluctuations or seismic loading, which may give rise to leaks. Also, design the glovebox structure for sufficient flexibility to allow joints to conform to one another during assembly, and to allow seals to function as the stresses built into the structure during fabrication relieve over the first few years of the glovebox's lifetime. Adequately support heavy equipment and shielding to eliminate adverse effects on gaskets and seals.

F. Design for glovebox flatness tolerances specified in 26Y-202001, "General Notes for Gloveboxes, Dropboxes & Introductory Boxes" for fabrication. Provide strength of materials calculations that evaluate in-process structural response from proposed live and dead loads; use a safety factor of 1.5 against yield strength. Evaluate and show acceptability of allowable load stresses and resultant load deflection against the following criteria:

> "Exterior surfaces flat to (+/-) 1/8-inch in any 2 feet length, and not to exceed (+/-) 1/4–inch over the entire length of the box."

NOTE: The method of analysis, qualified approximation, and judgments based on practical experience may be proposed by the design agency. Provide calculation and other materials supporting conclusions to LANL for review/approval; obtain LANL requestor and Mechanical POC approval of any exception to the deflection guideline via Request for Information. The design bases for the proposed configuration shall be examined and demonstrated by a comparable load test to ensure structural rigidity and leak integrity. Include appropriate load test procedural requirements as part of LANL Construction Specification 11610, "Glovebox Fabrication."

****

Define the design pressures of the glovebox.

****

G. Design the glovebox so that structural integrity of the glovebox shell, including panels and windows, withstands [negative 4.5-inches] w.g. for vacuum and [4.5-inches] w.g. for pressure. Structural integrity is defined as not exceeding the yield strength of glovebox shell materials. Ensure that specification Section 11610 includes testing and inspection requirements sufficient to verify structural integrity of the shell and windows when dead and live loads are applied. Provide strengths of materials calculations to demonstrate the glovebox shell structural integrity. Perform strength calculations utilizing a safety factor of 1.5 against yield strength. Evaluate allowable load stresses and resultant load deflection based on the criteria in Section 3.4.F.

****
Define atmospheric requirements within the glovebox and the appropriate oxygen and moisture levels within inert atmospheres, where required. If nitrogen must be removed from the atmosphere, define requirements for level of nitrogen concentration as well.

****

H. *Gloveboxes are sometimes used to maintain an inert environment as well as to contain special nuclear materials*. Design inert atmosphere gloveboxes to maintain atmosphere within the glovebox; mitigate the ingress of oxygen and moisture; and, prevent the migration of contaminant out of the glovebox. Design glovebox to maintain leak integrity of the primary confinement boundary and to maintain oxygen and moisture contents to less than [10, 100, 1000] parts per million by volume (ppmv).

I. Account for or limit the use of materials through which oxygen and moisture may permeate. Provide designs to mitigate permeation of oxygen and moisture through gloves, bagports, windows, service penetrations, and equipment interfaces.

****
Determine and specify the maximum size and mass of gloveboxes and glovebox sections so that gloveboxes may be transported into the site and facility of operation.

****

J. Modularize large gloveboxes to facilitate ease of manufacture and handling, transport to and access into plant at site, installation and decommissioning. Flange and join modules by bolting together and sealed using an established seal, normally a flat gasket. Maintain maximum size of each glovebox module to [XX-feet by XX-feet by XX-feet].

****
Determine and specify the operations to be performed within the glovebox so that the supplier may design the glovebox adequately.

****

K. Design gloveboxes so that simple maintenance and routine operating procedures may be performed through gloveports without undue hazards.

L. *Design the glovebox to minimize the potential for buildup of residual contaminants in gloveboxes that could result in chronic personnel radiation exposure by providing smooth finishes and easily decontaminated surfaces. Reduce the potential for accumulation of contaminants in gloveboxes by using a smooth finish throughout the glovebox; by rounding corners and floor-to-wall intersections; by having internal brackets attached to walls of the glovebox instead of the glovebox floor; and by eliminating crevices and abrupt intersections that may be created by intermittent welding on the interior of the glovebox. Design gloveboxes to allow for easy cleaning and decontamination.*

****
Perform radiation shielding and criticality analyses where appropriate to determine and specify shielding and criticality requirements below. Perform radiation shielding analysis and ALARA analysis, where necessary, in accordance with LIR-402-700-01. Perform criticality analysis in accordance with LIR 402-300-01. If these analyses are not performed by LANL, specify performance of radiation shielding, ALARA and criticality analyses by the supplier. Provide the supplier requirements for radiation shielding thickness, shielding type, configuration, and source term where applicable. For criticality considerations, provide maximum dimensions and configurations of items containing fissile materials to prevent criticality. Common materials for shielding of gloveboxes include lead, water, water extended polymer, and extra thickness of stainless steel. Also consult applicable LIRs, DOE Orders, and National Standards including the AGS Guideline for Gloveboxes, AGS-G001-1998, for further information.

Consider that in some cases, where beta emitters are being handled, unshielded glovebox gloves will reduce the extremity dose rate. Consult LA-UR-99-3596, *Photon and Electron Shielding for Neptunium-237*, for further information.

Where feasible, specify maximum tank diameter, slab tank dimensions, minimum separations, etc. in the specification to properly define criticality in lieu of having the design vendor perform criticality analyses. Specify dimensional requirements in place of LIR references when a supplier other than LANL designs the glovebox.

For critical applications, specify shielding verification using a source. Specify shielding verification in Section 11610 – Glovebox Fabrication.

****

3.5 SHIELDING AND CRITICALITY

A. Design shielding so that gaps between shielding are minimized. Stagger or overlap joints between lead sheets, for instance, to minimize “shine.” Pack gaps between lead with lead wool.

B. Minimize use of lead to mitigate concerns with the current environmental requirements over the disposal of mixed waste (such as material contaminated with lead). Design lead shielding to be covered with a cladding of stainless steel, where used. Where feasible and approved by LANL, use additional thickness of stainless steel in place of lead for shielding.

C. Where possible, design gloveboxes so that the use of fluids, including oils, hydraulic fluids, and water inside the primary confinement containing fissile materials is limited.

D. When water is used for neutron shielding, design the water wall cavity to be hydraulically leak-tight and to have the necessary structural integrity to support the hydrostatic loads. Ensure that the loss of water shielding due to pump down, draining, or establishing an inadvertent siphon is eliminated. Provide provisions for normal water shielding expansion, contraction, and level verification. Also provide couplings for filling and draining. Provide couplings with plugs.

E. Where gamma shielding is used in water wall gloveboxes, attach the lead to the outer shell.

F. Design glovebox parts out of metals wherever practical, due to their inherent ability to withstand radiation. Where this is not possible, Attachment 2 shows materials of good and poor stability; avoid use of materials with poor stability. Attachment 2 is based on accelerated irradiation (Dose D measured in Greys, Gy) at ambient- temperature in air and should only be taken as a guide. The values of absorbed dose are for negligible damage. The effect of radiation on individual material properties varies and the life of a particular component depends upon the limiting property. For critical components, carry out accelerated tests to measure the effect of radiation on the limiting property.

****

Determine and specify the applicable performance category (PC) of the glovebox. Where applicable specify floor response spectra, peak accelerations, damping ratios, etc. necessary for the supplier to perform seismic analyses. Follow the LANL Engineering Standards Manual Structural chapter. Determine and specify the performance requirements of the glovebox including the performance and leak integrity of the glovebox during and after a design basis earthquake (DBE). Also determine whether seismic analyses must be performed on the glovebox and to what extent.

****

3.6 SEISMIC DESIGN

A. Depending upon the quantity and characteristics of the materials being contained, design gloveboxes to withstand a design basis earthquake (DBE).

B. Refer to Section 13085 for additional seismic protection requirements.

C. The performance category of the glovebox is [PC-2, PC-3].

D. Perform seismic analysis of the glovebox in accordance with the applicable performance category requirements and as stated in DOE-STD-1020 and DOE-STD-1021 and LANL Engineering Standards Manual, Chapter 5, Structural.

E. In the seismic analysis, determine demand to capacity (D/C) ratios for the glovebox shell, support stand members, and the glovebox floor anchoring.

F. If the mass and center of mass of the equipment inside of the glovebox is unknown, increase the total calculated mass of the glovebox shell assembly by 25% to account for equipment and future additions to the glovebox internals.

G. Account for an accidental offsetting of the center-of-mass by 5% of the plan dimensions from the calculated location.

H. For PC-3 perform dynamic seismic analyses gloveboxes using commercial finite-element-analysis software that has been benchmarked and proven by the supplier. Examples of software include SAP 2000 and RISA-3D.

****

Determine and specify the human factors requirements and address the issues below. Where considered necessary by the author, specify the development of a human factors analysis for the glovebox. Consider that a human factors analysis requires knowledge of design of the equipment inside the glovebox. Provide details of equipment inside the glovebox, where applicable, so that the supplier may provide ergonomic design of the glovebox.

****

3.7 ANTHROPOMETRICS

A. Ensure that any part of the equipment or process within the glovebox requiring manual access is within effective glove reach.

B. Optimize design of glovebox (including any intervening radiation shielding) to account for the following:

1. Strength of operator.
2. Height and reach capability of operator.
3. The plane in which force must be exerted with relation to the rest of the body.
4. Direction of force, (i.e. push or pull).
5. Shape of the weight or control to be operated.
6. Length of time of exertion.
7. Dexterity of the operator.

C. *Design gloveboxes to fit a user population raging from the 5th percentile female through the 95th percentile male, unless otherwise specified. Where specific dimensions are cited in the following sections, it represents the limiting human design conditions*.

D. *Design gloveboxes such that the majority of glovebox tasks are performed within a normal work envelope, 11 to 13 inches, with a maximum of 18 to 20 inches*.

E. *Provide glovebox designs with dimensions for the front face of glovebox to the rear interior of glovebox, optimal dimensions for maximum accessibility as follows*:

1. *Single-sided access: Nominal 24 inches, maximum 26-inches (range from 18 to 26 inches), (5th female percentile)*.
2. *Double-sided access: Nominal 48 inches, maximum 52 inches (range from 36 to 52 inches), (5th percentile female)*.

F. Follow OSHA requirements set forth in 10 CFR 1910.120 and ANSI/IEEE 1023 Guide for the Application of Human Factors Engineering.

****
Provide the supplier with a conceptual sketch of the glovebox shell that will serve as a baseline for the supplier’s design.

****

3.8 GLOVEBOX SHELL

A. *The inner wall/shell of each glovebox requires regular routine cleaning to remove operational deposit. Make inner faces accessible within gloveport range and, as much as possible, unobstructed. Upper surfaces may be accessed using cleaning tools at the discretion of LANL*.

****
Note that welding of glovebox stiffeners to gloveboxes can cause warping of the shell when heat is applied near other welds and openings on the glovebox. Location of stiffeners and sizing of welds for stiffeners needs to be considered during design of the glovebox. Suggest the use of stitch welding to attach stiffeners to glovebox shells.

****

B. If glovebox stiffening is required, weld stiffeners externally to the glovebox, where practical. Provide stiffeners as plate, strip or sheet welded normal to the surface of the glovebox. Mechanical tubing stiffeners may also be used in lieu of plate strip or strip, where additional stiffness is required. Do not use mechanical tubing inside the glovebox without prior permission from LANL. Provide stiffeners of the same grade of stainless steel as the shell material. Requirements for stiffening materials including ASTM specifications are provided in Section 11610 – Glovebox Fabrication.

C. Provide clear areas near gloveports for mounting of arm and hand frisking radiation probes to facilitate hand and arm frisking immediately after removal from glovebox gloves.

****
Specify alternative corner radii for larger gloveboxes.

****

D. *Corners*

1. *Provide corners of gloveboxes with a minimum inside radius of 5/8-inch. For larger gloveboxes and lined gloveboxes, the radius may be larger. Provide corners of lined gloveboxes with 2-inch radius to assure proper application of the lining*.

****
Determine and specify the grade, type and thickness of stainless steel used in the glovebox design.

****

E. Material

1. *Design glovebox shells using 300-series stainless steel of type 304, 304L, 316, or 316L. Provide designs with stainless steel sheet material of 7 gauge, cold rolled, annealed, and pickled per ASTM A240 and ASTM A480, with a 2B mill finish*.

2. *Use plate stock of the same grade of stainless steel, when thicker material is required, such as for floors supporting heavy objects. Provide a continuous and contiguous transition between plate stock and sheet on the inner surfaces of the shell so that crevices within the glovebox interior are avoided*.

****

Determine and specify the number and type of hoods needed. Define limiting airflow within the facility in which the hood will be installed. If possible, provide a conceptual sketch of the hood that will serve as the baseline for design. Determine whether the hood will need to be closed. Specify the type of system to use to bypass airflow around the hood or through the hood when the hood is closed. This can be achieved through a filtered bypass duct next to the glovebox or by providing another filtered opening on the hood so that air may flow through the glovebox when the glovebox is closed. Airflow may also be reduced regulated using variable airflow venturi style dampers, such as those manufactured by Phoenix Controls, provided in the facility ductwork. If airflow must be shut-off a butterfly valve with edge seals will be required. If appropriate, define appropriate leak integrity for the door that provides the confinement.

****

3.9 HOODS

A. Design hoods to maintain confinement of hazardous materials and particulate through airflow. Design to maintain air flow velocities across hood openings at 125 ± 25 fpm in accordance with DOE Order 6430.1A, Division 11, the American Conference of Governmental Industrial Hygienists (ACGIH), and the American Glovebox Society Guideline for Gloveboxes.

B. Minimize the number of openings into the hood to maintain appropriate flow velocities and to minimize airflow.

C. Design the hood so that it may be closed providing a confinement of appropriate leak integrity.

D. Provide clear areas near opening for mounting of arm and hand frisking radiation probes to facilitate hand and arm frisking immediately after removal from glovebox gloves.

****

Determine and specify the material used for the support stand to meet LANL facility requirements. Determine and specify other support stand requirements such as height of stand to mate the glovebox with other gloveboxes, adjustability of support stand height, field location requirements of anchoring, etc.

****

3.10 SUPPORT STANDS

A. Support gloveboxes by a fabricated support stand, bolted to the glovebox base. Design the support stand for anchoring the glovebox to the facility floor. Fabricate the support stand from stainless steel or carbon steel structural shapes. Where carbon steel is used, provide a decontaminable coating on to the steel. Refer to the painting section of this specification.

B. Refer to Section 05120 – Structural Steel and Section 11610 – Glovebox Fabrication for requirements of structural steel.

C. Design glovebox support stands in accordance with LANL Engineering Standards Manual, Chapter 5, Structural, and to meet appropriate performance category (PC) requirements in accordance with DOE-STD-1020 and DOE-STD-1021.

D. Where practical, provide a support stand design that allows for vertical adjustment at installation. Shimming of glovebox support stands with shims greater than 1/4-inch thickness is prohibited. Avoid design of glovebox support stands that require field welding.

E. Where a support stand is not required, design the glovebox for anchoring directly to the facility floor.

F. Where determined by the seismic analysis to be necessary, provide corner gussets or diagonal braces with the support stand. Design diagonal braces for bolted attachment to the support stand upright members.

G. When feasible, include a horizontal bar in the stand that can be used as a foot rest.

****
Determine and specify the number and type of airlocks required. Determine and specify minimum size of the airlock, airlock door types, the necessity for a slide tray, materials of construction, and configuration of airlocks. At a minimum, specify the maximum size and weight of materials or items to be passed through the airlock. Also specify the number and types of penetrations on the airlock for purging operations. Provide a hood to enclose the airlock when using the airlock to remove items from primary confinement. Potentially contaminated items should be withdrawn into a hood where they can be assayed, bagged, etc.

****

3.11 AIRLOCKS

A. *Size airlocks based upon the size of the items to be passed through them. Do not provide gloveports on airlock confinements*.

B. *Where required, provide a slide tray within the airlock for easier transfer of materials and items*.

C. *Provide administrative or designed controls so that both doors cannot be opened at the same time*.

D. Provide evacuate/purge capability and connections on the airlock to exchange the airlock atmosphere. Include in-line HEPA filtration in piping for evacuation and purging of glovebox. Refer to Section 15865, Filters.

****
Determine and specify either the equipment and operations inside the glovebox OR the prescribed gloveport placement so that gloveports may be located effectively. Also specify the size and type of gloveports. Specify accessories to gloveports including plugs and covers. Consider providing multi-adjustable footstools for operators.

****

3.12 GLOVEPORTS AND GLOVEPORT PLACEMENT.

A. Design gloveboxes for the use of push-through gloveports from Central Research Laboratories (CRL) of the round or oval shape for gloveboxes. Provide gloveports welded into the glovebox shell or clamped into windows. Note that o-ring seal material for the rings and bungs will require selection based on the glovebox environment.

B. Provide gloveports of the rolled and welded type or CRL push-through type for hoods.

C. *Locate gloveports to facilitate replacement of gloves without breaching confinement*.

D. *Use oval-shaped or large-diameter gloveports when increased functional reach capability is required*.

E. *Place centerline height of primary, working gloveports between 48-inches and 52-inches in height from finished floor to centerline of gloveport*.

F. *Provide spacing between horizontal centerlines of a working pair of gloveports at nominally 16.5-inches (range between 15 and 18-inches)*.

G. Provide spacing between vertical centerlines of a working pair of gloveports at nominally 18-inches (range between 16 and 19-inches).

H. *For reach capability, maintain horizontal centerline of nearest row of gloveports to glovebox top/bottom at 18-inches.*

****

Bolted window assemblies are preferred for use in gloveboxes to be installed at TA-55. Determine and specify the window types, viewing pane material, size and placement. If size and placement is not provided, provide a description of equipment and operations inside the glovebox so that windows may be sized and placed appropriately by the supplier. Specify placement of gloveports in windows. Determine and specify whether shielding on windows is required. Specify thickness and materials of shielding and connection of shielding glass to the window frame. Lexan® may be used on tritium gloveboxes; however, safety glass is recommended due to its low combustible loading.

****

3.13 WINDOWS

A. Provide windows of either the zipper window style or the clamp-strip style. Window details for both styles are provided in the Attachment 1.

B. Where greater visibility is required, construct the glovebox walls so that large windows may be placed on the operational surfaces of the glovebox. Provide gloveports mounted in the windows.

C. Use clamp-strip style windows in gloveboxes containing plutonium or tritium. Use C-channel gaskets as shown in the Attachment 1 drawings.

D. Provide fire shields inside the glovebox on zipper window gasket assemblies. Use largest acorn nut/studs feasible or other means to fasten the fire shields to the glovebox to allow for easy manual removal/installation with or without tools.

E. Provide strength of materials calculations for glass thickness based upon design pressure of glovebox. Perform strengths of materials utilizing a safety factor of 3 against yield strength.

F. Provide shielding glass where additional radiation shielding is required. Provide shielding windows consisting of two frames with one frame holding glass and providing confinement and the other frame holding shielding glass and providing shielding.

G. *Select materials based on transparency, and resistance to fire, abrasion, corrosion, puncturing, tritium exchange, and water vapor permeation as necessary.*

H. *Maximize size to optimize visibility, with the goal of minimizing blind spots.*

I. *Provide horizontal centerline placement at eye level: 61 to 63 inches above finish floor for standing operations, centered above pair of gloveports. The 5th percentile female eye height is 55.5-inches, and the 95th percentile male eye height is 68.2-inches.*

J. *Use a sloping glovebox face, 10° to 15° maximum, where feasible, to reduce glare and potential blind spots and to enhance vision and working posture.*

****
Determine and specify lighting requirements in footcandles (fc) or lumens for the glovebox. Also specify whether the supplier will provide lights and the type of lights required.

****

3.14 *LIGHTING*

A. *When using non-fluorescent lighting, provide methods to adjust lighting levels both inside and outside the glovebox to minimize glare. Design with approximately 100 footcandles (fc) at the work surface*.

B. *Provide luminaries with baffles to diffuse light, and ensure light tube is not directly visible to a user's eye*.

****
Determine and specify lifting requirements including any LANL specific hoisting and rigging requirements to which the glovebox must be designed.

****

3.15 LIFTING POINTS – GLOVEBOX STRUCTURE

A. Incorporate lifting features, (i.e. bolts or lugs) into the glovebox design as required. Design and position lifting features to prevent distortion of the glovebox. Design lifting features to accept lifting by forklift and crane and mark features appropriately.

B. Where lifting eyes are not provided as a feature of the design, indicate suitable lifting points on the main glovebox framework. If the framework is not adequate to take the load, provide external strong-backs or other bracing devices.

C. Design gloveboxes so that they can be lifted from below the support frame, which is bolted to the glovebox shell.

D. Refer to Section 14610, Hoists and Trolleys, for further guidance on design, fabrication and implementation of hoists and trolleys in gloveboxes.

3.16 WELD STUDS AND FASTENERS

A. Provide sufficient clearance for box end wrenches or socket wrenches where hexagon headed bolts and acorn nuts are used, per ASME B18.2.1. Minimize the range of bolt sizes in the design of the glovebox (1/4-inch to 3/4-inch) in order to limit the number of tools required. Other cap screw and bolt sizes may be used as approved by LANL.

B. Position fasteners inside of gloveboxes for ease of access via gloveports and visibility through glovebox windows. Provide sufficient space manipulate tools for the loosening/tightening of fasteners.

C. Do not penetrate the glovebox shell with fasteners since leakage can occur past the screw threads. Where items must be attached to the glovebox shell such as access panels, services panels, windows, etc., provide pattern of weld studs of appropriate size and spacing around a shell opening to allow attachment and appropriate sealing of the component. Blind tapped holes on the outside of the glovebox shell are also allowed when there is sufficient shell thickness to allow for proper screw thread engagement.

D. Do not use screws or any other fastener inside a glovebox that would require use of a tool such as a screwdriver or Allen wrench that could puncture a glove.

E. Where feasible, provide designed fastened joints such that screw thread engagement length is at least 1-1/2 times the diameter of the screw.

F. Avoid the use of grub screws, knurled or slotted head fasteners, spiral pins, circlips, split pins, and locking wire unless specifically approved by LANL.

G. Do not use high tensile steel fasteners in the construction of lifting equipment.

H. Select materials for stainless steel threaded components carefully to minimize the possibility of galling and seizure. For this reason, do not use non-approved threaded components in place of specified requirements. When selecting dissimilar materials to prevent such occurrence, in general, provide the nut or one material of type 304L stainless steel and the mating material of ferritic stainless steel.

I. Apply anti-seize compound to mating stainless steel threads prior to assembly.

****
Determine and specify the types of filter housings required, including materials of construction, configuration and size. Gloveboxes where radioactive particles may be suspended in the atmosphere require HEPA filters at the point of exhaust from the glovebox. If there is a supply directly to the glovebox, it requires a HEPA filter to prevent backflow of contamination. Normally tritium boxes have gaseous radioactivity where HEPA filters do not provide protection. Occasionally, tritium applications do involve dusty tritium contaminated material. In those cases a filter will be needed.

****

3.17 VENTILATION AND FILTER HOUSINGS

A. For once through air-ventilated gloveboxes, design the steady state airflow so that air will be drawn through the largest credible rupture (open gloveport, open bagport, etc) with a velocity of 125 fpm. Design to achieve open port flow without action by a control valve

B. Provide glovebox inlet filter housings of an in-line type and fabricated from stainless steel. Provide plywood filter housings for inlet filters with prior approval from LANL.

C. Size outlet filters and filter housings for gloveboxes for appropriate flow and pressure drop. Utilize the Industrial Ventilation manual from the American Conference of Governmental Industrial Hygienists (ACGIH).

D. Design outlet filter housings for fabrication from 300-series stainless steel. Provide filter housings of the push-through type for safer change-out of filters. Refer to Attachment 1 for design details of push-through filter housings.

E. Refer to Section 15885 – HEPA Filters for specification requirements of HEPA filters including in-line HEPA filters in supporting glovebox utilities and glovebox inlet/exhaust HEPA filters.

F. During glovebox design consider the following requirements related to HEPA filtration. Provide in-line HEPA Filters intended for the removal of aerosol particles from sample or exhaust gas streams that are potentially contaminated with hazardous material.

1. Install filter units on vacuum lines and other piped utilities as close to the process enclosure confinement boundary as possible. Consider design configuration so as not to impose a pressure differential on critical indicator gauges.
2. Size outlet filters and filter housings for gloveboxes for appropriate flow and pressure drop.
3. Construct filter housing of 300 series stainless steel. Select other materials that have the most desirable outgassing properties.
4. Protect pumps and other costly mechanical equipment with filter upstream and downstream of unit. Size pumps with appropriate consideration for the pressure drop/conductance loss due to filter media (the time required to evacuate a system may be drastically increased).
5. Standard NPT connections can be used for low or rough vacuum service. Consider VCR® metal face seal fitting end connection for high vacuum leak-tight service.
6. Provide sample or exhaust line HEPA filters per Section 15865 -- Filters.
7. Consider in-line capability with filter media totally contained and disposable with filter housing without disconnecting sample lines to facilitate maintenance procedures and minimize potential hazards.
8. Provide for a metal face seal fitting at upper and lower filter housing assembly.
9. HEPA filter units require a pressure leak test by the manufacturer and installation agency.

****
Determine and specify the number, types, and configuration of shell penetrations and interfacing utilities.

****

3.18 SHELL PENETRATIONS AND UTILITIES

A. Where feasible, locate ventilation inlet and outlet penetrations in diametrically opposite corners of the glovebox to allow for proper flushing of the glovebox atmosphere. Provide HEPA filtration for ventilation inlet and outlet penetrations.

B. Where practical, locate service penetrations for utilities on service panels that allow for easier modifications to the glovebox penetrations in the future.

C. At a minimum, provide shell penetrations for the following utilities: ventilation inlet, ventilation outlet, magnehelic / photohelic connections, fire detection.

D. Provide magnehelic / photohelic located on the glovebox shell so that it is possible for operators to view the gauges without removing their hands from the gloves. Provide one magnehelic / photohelic gauge above or between the main viewing windows, one for every two operator stations.

E. Provide a nominal amount of spare connections in service panels for future use.

F. Where practical, pipe services inside and outside of gloveboxes in stainless steel. For connections where rigid pipe work is not practical, provide alternative connection systems with approval by LANL.

G. Do not provide connections / fastenings of the hose clamp type. Where feasible, use quick release type, self-sealing couplings with flexible connections inside of gloveboxes. Ensure that the glovebox design provides sufficient access to make / break these types of connections and that it does not pose a hazard to operators.

H. Refer to Section 15215 for requirements of compression fittings for copper and stainless steel tubing. Use face-seal fittings (o-ring or metal gasket) for tubing in critical leak tight applications.

I. Run services in such a way that they can be accessed via gloveports if replacement becomes necessary.

J. Run services around the perimeter of the glovebox so that they do not interfere with the requirements for routine access to the glovebox.

K. Use small-bore pipe supports integral with the glovebox shell, with prior approval from LANL. Do not use self-adhesive clips.

L. Fit services run inside gloveboxes with durable and easily readable fixed labels which do not have sharp corners, remain fixed in the original positions and do not become unreadable as a result of time or radiation. Provide mechanical identification of penetrations in accordance with Section 15075.

M. Unless otherwise specified, do not route service pipes through the glovebox base, as this inhibits cleaning and decontamination of the base.

N. Provide flow-limiting orifices for any compressed gas services greater than 20 psig, to prevent over-pressurization of the glovebox in the event of a line rupture or accidental un-restricted flow into the glovebox.

****
Determine and specify the number, types, size and configuration of access and service panels. Panel removal must not be used as a routine operation. Panels will only be removed as a last resort, perhaps only once in the lifetime of the plant.

****

3.19 ACCESS AND SERVICE PANELS

A. Equip gloveboxes with removable access panels to facilitate equipment installation and/or removal. Where fitted, provide panels capable of maintaining glovebox integrity using a gasket seal.

****
Determine and specify the number, types, size and configuration of material transfer devices for gloveboxes. Use input sphincters for input of devices only. Use double-door transfer systems for materials transfer operations between confinements. Double-door transfer systems provide a safe means to transfer materials without contamination of the working environment. Double-door transfer systems are also known as Alpha-Beta Transfer Doors, Rapid Transfer Ports, etc.

****

3.20 MATERIAL TRANSFER DEVICES

A. Provide material transfer devices including [bagports, double-door transfer systems, airlocks, input sphincter, introductory tubes]. Attachment 1 of this section provides design details of some of these material transfer systems.

B. Place bagports on the base of the glovebox or on the side. Where bagports are used on inert atmosphere gloveboxes with stringent purity requirements, provide a cover on the inside and outside surface of the bagport to mitigate migration of oxygen and moisture through the attached bag.

C. Provide bagports with rings or indentations to allow for easier placement of attachment clamps or rubber rings when performing bagport operations.

****
Determine and specify the type, thickness and configuration of glovebox linings or coatings where needed*. Protective coatings and linings have been used successfully under specific conditions in gloveboxes for many years. The chemical structure of some materials provides the required resistance to the environments typically found in nuclear and chemical processing. Evaluate coating or lining materials for resistance to radiation, chlorides and chemical before use. Coating and linings can be applied using various techniques. They provide a cost-effective solution to process problems. Some coatings may contain solvents or processing aids that could interfere with long-term performance. Evaluate each coating system carefully. For specific information about the testing, installation and quality control of linings, refer to the AGS Guideline for Gloveboxes, AGS-G001-1998, Section 7.*
The current glovebox lining specification in force at TA-55 is NMT8-PS-09850.
****

3.21 GLOVEBOX LININGS

****
Determine and specify the type of pressure relief device to be used with the glovebox. If the supplier is not providing the pressure relief device, provide appropriate specifications for interface of pressure relief devices such as pressure relief devices (bubblers) or pressure control valves. Define the maximum operating pressure and relief pressure below. Consider the use of either pressure relief devices (bubblers) or pressure control valves during the development of hazard analyses since each system has inherent hazards.

****

3.22 PRESSURE RELIEF DEVICES

A. Refer to Section 11620 – Glovebox Installation for requirements related to pressure relief devices (bubblers).

B. Provide over-pressure and under-pressure relief on gloveboxes using pressure relief devices (bubblers) or pressure control valves.

****
Determine and specify other glovebox appurtenances specific project requirements. Prior to specifying reciprocating shaft feedthroughs, consider the possibility of contaminant transport out of the glovebox. Provide information regarding the equipment inside of the glovebox so that shaft feedthroughs, guards, and lifting equipment may be employed in the design.

Evaluate the adverse effects of glovebox atmospheres including inert atmospheres on component operation. Consider the potential for increased failure, maintenance and replacement problems on glovebox components in the design of the glovebox shell.

****

3.23 OTHER GLOVEBOX APPURTENANCES

A. Shaft Feedthroughs

1. Where rotating shafts pass through the glovebox shell, use a cartridge type seal. Utilize magnetic coupling systems in lieu of shaft penetrations where technically feasible.
2. Provide a cartridge design that consists of the bearings and seals in a common housing, fixed to the glovebox shell, enabling defective seals / bearings to be replaced without losing confinement, (i.e. the new cartridge pushes the old one into the glovebox).

B. Guards

1. Guard equipment inside of gloveboxes with moving parts or any other mechanical or electrical equipment of potential risk to operations or maintenance staff in such a manner to satisfy Occupational Safety and Health Administration (OSHA) requirements.
2. Provide guarding of equipment within a glovebox so that equipment is still maintainable. Provide guards that are easily removable and attached by fasteners.
3. Determine and eliminate traps created by moving parts, or by actuation of levers, so that safe operations can be performed. Guard access to dangerous parts of moving machinery in compliance with the guidelines set out under 10 CFR 1910 Subpart 0.
4. Provide lockout / isolation points to de-energize moving machinery during operation or when maintenance is required to be performed (see OSHA lockout / tagout standard 10 CFR Part 1910.145).

****

Hoist/trolley dead load and rated live load capacity shall be considered in the overall glovebox shell and stand design. Acceptable deflections and stresses must be established by the glovebox designer based upon the performance requirements of the glovebox. Performance requirements of the glovebox may include leak-tightness and structural integrity before/during/after design basis accidents. Consideration shall be given to design basis accident scenarios including dropped loads, swinging loads, and natural phenomenon hazards such as seismic events.

****

C. Lifting Equipment

1. Where lifting equipment is required, provide the equipment in accordance with the following requirements, CMAA-70, ASME B30.16, ASME B30.2.1, ASME HST-4M, and ASME HST-3M.
2. Where lifting equipment inside of the glovebox is performing “critical” lifting operations, apply ASME NOG-1 for design, manufacture, installation and operation of the lifting equipment.
3. Design lifting equipment so that statutory examinations can be performed.
4. Design lifting equipment so that replacement/servicing of glovebox equipment (including the lifting equipment itself) can be performed safely.
5. Provide lifting equipment ‘light’ enough to be manipulated into place by hand via glove ports.
6. Provide protection of equipment below the lifting area from dislodged/dropped loads.
7. Refer to Section 14610 – Hoists and Trolleys for further requirements for hoists and trolleys within gloveboxes.

3.24 HEAT LOAD MANAGEMENT

A. Provide means to limit heat loads within gloveboxes in a criticality-safe fashion. Locate furnaces and heat sources outside of gloveboxes so that cooling water is not introduced inside the primary confinement. Utilize cooling wells where feasible.

****
Do not delete the following reference information.
****

FOR LANL USE ONLY

This project specification is based on LANL Master Construction Specification Rev. 1, dated September 3, 2003.

Section 11608 - Attachment 1
Glovebox Drawing List

Drawing #	Drawing Title
26Y-202001	General Notes
26Y-202002	Lead Shielding & Cladding for Zippered and Bolted Gloveboxes
26Y-202005	Lead Glass Shields for Zippered and Bolted Windows
26Y-202006	Zippered Window Assembly
26Y-202008	Bolted Window Assembly
26Y-202010	Shell Penetrations
26Y-202013	Typical Gloveport Ring
26Y-202014	Bolted Service Panel Assemblies
26Y-202015	Top Access Panel Assembly
26Y-202018	Bag Ring Assemblies
26Y-202019	Removable Shelf Assembly
26Y-202021	Cooling Well Assembly
26Y-202022	Resistance Furnace Well
26Y-202023	14” Dia. Airlock Assembly
26Y-202024	Standard Airlock Slide Tray Assembly
26Y-202026	Connector Ring Closure Cap Assy & Connector Assy
26Y-202031	14” Dia. Welded Connecting Ring Assembly
26Y-202032	Sample Taking Port Assembly
26Y-202034	Reagent Transfer Device Assembly
26Y-202035	Introductory Tube Assembly
26Y-202039	16” Square Connector Assembly
26Y-202046	Air Cylinder Mounting Assembly
26Y-202047	Air Operated Vertical Sliding Door Assembly
26Y-202048	14” Dia. Opening Counterbalanced Door Assembly 151 R/L
26Y-202049	16” Square Airlock Sliding Door--Hydraulic
26Y-202050	14” Dia. Opening Air Operated Vertical Sliding Door Assy
26Y-202052	Introductory Boxes and Hoods Exhaust Transition Piece
26Y-202053	Introductory Boxes and Hoods Upper & Lower Door Assy’s
26Y-202057	8” Dia. Exhaust (HEPA) Filter Assembly
26Y-202059	8” Filter Housing Assembly
26Y-202060	Pressure Relief Device 161 Assembly
26Y-202066	Std. Hi-Vac System Diffusion Pump Mounting Flange Assy
26Y-202067	Dutchman Assembly
26Y-202075	Tunnel Dropbox Transition with Firedoor Assy (2 dr)
26Y-202076	Typical Dropbox Detail Bolt Pattern for Transition
26Y-202077	Tunnel Dropbox Transition with Firedoor Assy 167 (1 dr)
26Y-202121	2 x 3 Glovebox Support Stand Assy
26Y-202122	2 x 2 Glovebox Support Stand Assy
26Y-202123	1 x 3 Glovebox Support Stand Assy
26Y-202124	1 x 2 Glovebox Support Stand Assy
26Y-202125	1 x 1 Glovebox Support Stand Assy
26Y-202130	12” Dia. Exhaust (HEPA) Filter Assembly
26Y-202131	Neutron Shielded Glovebox Details
26Y-202150	O-Ring Gasket Seal Tubing to Valve Joint

Drawing #	Drawing Title
26Y-202151	3” and 2 1/4” I.D. Damper Assembly
26Y-202152	4” In-Line Filter Holding Bracket
26Y-202153	Open-Front Glovebox 7 1/2” Sash Assembly

Section 11608 - Attachment 2
Materials Subject to Radiation

Material	Stability		
	Good 10^5 Gy	**Satisfactory** 10^4 Gy- 10^5 Gy	**Poor (Do not use)** 10^4 Gy
Rubber ASTM D 2000 ASTM D 1056	Polyurethane (1) SBR Butadiene styrene Ethylene propylene copolymer (2) EPDM Polychloroprene (5)	Natural Rubber Butadiene-acrylonitrile copolymer NITRILE Polysulphide Polybutadiene	Fluorocarbon (3) VITON Butyl Silicon (4) Neoprene
Thermoplastics	Polystyrene Polyethylene Chlorosulphonated Polyformaldehyde Hypalon ABS PVA Polyamide (6) Nylon Polycarbonate Polyester (7) Mylar or Melinex	Polymethylmethacrylate PERSPEX Chlorofluorocarbon (8) KEL-F	Fluorocarbon (9) PTFE, Teflon, Fluon Polypropylene
Thermosets	Epoxy Resin ARALDITE Styrene modified polyesters (10) (Mineral or unfilled) Polyurethane (1) Polyetheretherketone EEK Silicone (11)		Styrene modified polyesters (10) (unfilled) Amino-Formaldehyde Phenol formaldehyde BAKELITE
Adhesives	Epoxy Resin ARALDITE Phenolics (12)		Pressure sensitive type (13)
Lubricants	Mineral Oils (14) (radiation resistant grades)	Synthetic Lubricants (14) & (15)	Natural Oils (Vegetable etc.)
Others	Metals Concrete Glass (16)	Cork & Wood (17)	

NOTES:

(1) Polyurethane can be either polyether or polyester based. Polyether based polyurethanes are some of the most radiation resistant rubbers. However polyesters are susceptible to hydrolysis and should not be employed in humid radioactive environments.

(2) Ethylene propylene copolymers are the most radiation stable rubbers.

(3) Fluorocarbons release highly corrosive fluorine/hydrogen fluoride on irradiation.

(4) Silicone rubbers are composed of an inorganic backbone of silicon and oxygen with organic side groups. The side groups may break off during irradiation thus affecting the characteristic properties of the material. There is also the possibility of the side groups containing corrosive halogens.

(5) Polychloroprenes degrade under irradiation releasing corrosive chlorine/hydrogen chloride.

(6) Polyamides include the nylons in which damage is caused by the combined effects of ionizing radiation and oxygen. Therefore the size of the component (surface to volume ratio) will affect the radiation stability, larger components will survive longer.

(7) Polyesters are susceptible to hydrolysis. Therefore their stability is greatly reduced in moist conditions.

(8) Chlorofluorocarbons will release corrosive halogens during irradiation.

(9) Fluorocarbons degrade rapidly in radioactive environments and are also affected by oxygen (See Note 6above). Fluorine is liberated which is highly corrosive.

(10) Styrene modified polyesters exhibit a range of radiation stability dependent upon whether or not they are filled. The presence of inorganic fillers reduces radiation damage of the polyester. This is due to the radiation being absorbed throughout the component and inorganic materials are little affected by radiation.

(11) Silicone based Thermosets are more resistant to radiation than their rubber counterparts due to the presence of stable styrene side groups and fillers. (See Note 10 above).

(12) Formaldehyde Phenolics have very poor radiation stability.

(13) Some adhesives release vapors during curing so that pressure should be applied evenly to bond areas to avoid porous joints.

(14) Aromatic lubricants (containing closed ring molecules/benzene rings) are more resistant to radiation than aliphatics (straight chain modules).

(15) Almost all synthetic lubricants do not offer any advantage over mineral oils in terms of radiation stability. However, they may be used when their increased fire resistant, chemical and thermal stability are required.

(16) Radiation stabilized glass should be used if discoloration transmission loss cannot be tolerated.

(17) Cellulose based materials degrade in radiation and release fumes. The material eventually becomes tacky.

Section 11608 - Attachment 3
Glovebox Design Checklist

1.0 Form

1.1 Are the glovebox internal / external surfaces decontaminable? - Is the proposed surface finish, suitable for the requirement?

1.2 Does the glovebox have clean lines? Is it self-draining / self-cleaning with no powder traps?

1.3 Does the glovebox have a simple shape with the minimum of fabrication and machining?

1.4 Is glovebox sized appropriately to allow for installation into the facility? Has the design of the glovebox considered the path of transport the glovebox must take to be installed?

2.0 Manufacture

2.1 Materials

2.1.1 Is stainless steel required?

2.1.2 Are materials compatible to each other and to the process?

2.1.3 Do the materials of manufacture give suitable shielding protection?

2.1.4 Are Jigs / Fixtures / Tooling required or necessary to aid in manufacturing?

2.1.5 Are flammable or combustible liquids used?

2.1.6 Are Class A combustibles used? Has prior approval been obtained?

2.1.7 Are materials covered by the Resource Conservation Recovery Act (RCRA) used that may cause a mixed waste disposal problem?

2.2 Fasteners

2.2.1 Is the fastener material compatible with the parent material?

2.2.2 Are the sizes of fasteners standardized throughout the glovebox?

2.2.3 Are acorn nuts used? – Have sharp corners on exposed nuts been removed?

2.2.4 Are captive fasteners required to aid maintenance?

2.2.5 Are fasteners accessible by boxed end wrenches or sockets?

2.3 Lubricants

2.3.1 Are lubricants necessary within the glovebox?

2.3.2 Can the lubricated item be placed outside the glovebox - through wall drive system?

2.3.3 Are lubricants required to be radiation tolerant?

2.3.4 Does the lubricated item require re-lubricating on a regular basis?

2.3.5 Are there reservoirs for lubricants?

2.3.6 Are the flashpoints of the lubricants below 400° F?

3.0 Viewing and Access

3.1 Are the viewing lines through windows believed to be acceptable for normal operation?

3.2 Are the viewing lines through windows believed to be acceptable for maintenance operations?

3.3 Is the access into the glovebox believed to be acceptable for normal operation? - Are there any restrictions i.e. other equipment features or fittings?

3.4 Is the access into the glove box believed to be acceptable for maintenance operation? - Are there any restrictions i.e. other equipment, features or fittings?

3.5 Do the viewing materials give suitable shielding protection?

3.6 Are there any special viewing requirements? - Inspection purposes, etc.

4.0 Maintenance

4.1 Do removable items fit into the bagport / material transfer port envelope?

4.2 Are suitable set down areas provided within the glove box confinement?

4.3 Are there any special recovery requirements?

4.4 Can modular items inside glovebox be manually handled (less than 13 lb.), or is material handling equipment required?

4.5 Is calibration equipment provided for material handling equipment (e.g. test weights)?

5.0 Calculations and Data Sheets

5.1 Are sizing and other calculations available?

5.2 Are manufacturers specifications available?

5.3 Is shielding adequate?

5.4 Is structural integrity appropriate to meet performance requirements? Can glovebox structure and shell resist design loads including seismic loads and differential pressure loading?

5.5 Check mass and facility floor loading.

6.0 Ventilation

6.1 Has the ventilation of the glovebox been considered?

6.2 Does the glovebox contain powder or solid material?

6.3 Does the glovebox maintain capture velocity at opening when and opening is breached?

6.4 What is the atmosphere within the glovebox? If an inert gas, will instrumentation continue to function?

6.5 Is there potential for static atmosphere within the glovebox?

7.0 Operation

7.1 Does the glovebox perform its required operation?

7.2 Could the operation be simplified?

7.3 Could the time at the glovebox face be reduced to lower operator dose?

7.4 Have suitable number of penetrations for utilities and electrical services been provided to allow for installation, operations, and maintenance?

7.5 Are spare penetrations provided for expansion and addition of utilities/electrical service connections?

Section 11608 - Attachment 4
List of Required Submittals

****

The following list of required submittals is an example of the submittals required in association with the glovebox design and fabrication specification. This list is not comprehensive. Modify the list accordingly and provide the submittal requirements for project-specific gloveboxes with Section 01330 – Submittals.

****

Section No: 11608			Type of Submittal			Submittal Schedule and Number of Copies				
Section Title: Gloveboxes										
DESCRIPTION OF SUBMITTAL REQUIRED		SPECIFICATION LOCATION	FOR INFORMATION	FOR ENGINEERING REVIEW, COMMENT, & APPROVAL	FOR INSPECTION & ACCEPTANCE	AT PREFABRICATION CONFERENCE	PRIOR TO FRABRICATION	WITH SHIPMENT	7 WORKING DAYS ADVANCE NOTICE	AS REQUIRED
	30% Design Documents									
	Design Drawings									
	60% Design Documents									
	Design Drawings									
	90% Design Documents									
	Design Drawings									
	Seismic Analyses									
	100% Design Documents									
	Final Design Drawings (stamped and signed)									
	Final Seismic Analysis (stamped and signed)									
	Lower Tier Services Plan		X			1				
	Quality Assurance Manual (Design)									